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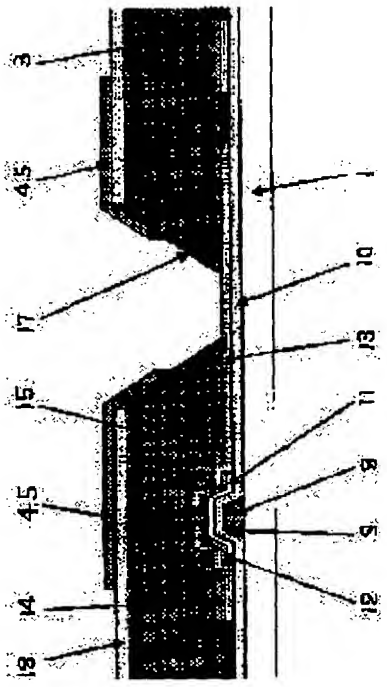
(54) LIQUID CRYSTAL DISPLAY DEVICE AND ITS PRODUCTION

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a liquid crystal display device of both transmission and reflection type, with which an always stable display grade is obtained by specifying the effective display areas of the transparent electrodes and reflection electrodes in the pixel parts of the liquid crystal display device of both transmission and reflection type always constant.
SOLUTION: The liquid crystal display device of both transmission and reflection type is constituted, by taking the misalignment of interlayer insulating films 3 and reflection electrode materials 4 and 5 into consideration so as to avoid the direct contact of the electrode material constituting the transmissible display part and the electrode materials 4, 5 constituting the reflection display part in the boundary region of the transmissible display part and the reflection display part. More specifically, a stepped sloping part having a gradient is formed in the boundary region of the transmissible display part and the reflection display part of the interlayer insulating films 3 and the ends of the electrode materials 4 and 5 constituting the reflection display particularly are positioned on the stepped sloping part of the interlayer insulating films 3.



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CLAIMS

[Claim(s)]
[Claim 1] On the substrate of the one side of the substrates of the couple which counters mutually and is arranged on both sides of a liquid crystal layer In the liquid crystal display with which it comes to form the pixel electrode which constitutes the reflective display which reflects outdoor daylight, and the transparency display which penetrates the light from the source of a back light in 1 pixel While the reflective display and transparency display which constitute the aforementioned pixel electrode are constituted by the electrode material, respectively Through a layer insulation film, these electrode materials superimpose a part or all, and it comes to constitute them. on the aforementioned layer insulation film The liquid crystal display characterized by being constituted so that the edge of the electrode material which constitutes the aforementioned reflective display may be located on the level difference ramp of the aforementioned layer insulation film, while the level difference ramp which has inclination is formed in the border area of the aforementioned reflective display and a transparency display.
[Claim 2] The manufacture method of a liquid crystal display of coming to form the pixel electrode which constitutes the reflective display which reflects outdoor daylight on the substrate of the one side of the substrates of the couple which counters mutually and is arranged on both sides of the liquid crystal layer characterized by providing the following, and the transparency display which penetrates the light from the source of a back light in 1 pixel. the above -- the process which carries out patterning of the transparent-electrode material, and forms it on the substrate of one side including the field which constitutes a transparency display even if few the above -- the process which carries out patterning of the layer insulation film, and forms it on the aforementioned transparent electrode including the field which constitutes a reflective display even if few The process which carries out patterning of the reflector material to the field which constitutes the reflective display on the aforementioned layer insulation film, and forms it in it. It ****** and is inclination to the border area of the reflective display of the aforementioned layer insulation film, and a transparency display.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the liquid crystal display used for the camcorder/movie equipped with OA equipment, such as a word processor and a personal computer, pocket information machines and equipment, such as an electronic notebook, or the liquid crystal display monitor etc., and its manufacture method.
[0002]
[Description of the Prior Art] In recent years, the liquid crystal display is widely used for a word processor, a personal computer, television, a video camera, a still camera, a mounted monitor, pocket OA equipment, the handheld game machine, etc. taking advantage of the feature of being a low power, with the thin shape.
[0003] A transparency [which used transparent electrodes, such as ITO (Indium Tin Oxide), for the pixel electrode] type liquid crystal display, and the reflected type liquid crystal display which used reflectors, such as a metal, for the pixel electrode are shown in such a liquid crystal display.
[0004] Originally, liquid crystal displays differ in CRT (Braun tube), EL (electroluminescence), etc., since they are not the spontaneous light type display which emits light itself, in the case of a penetrated type liquid crystal display, arrange lighting systems, such as a fluorescence pipe, and the so-called back light behind a liquid crystal display, and show to it by the light by which incidence is carried out from there. Moreover, in the case of a reflected type liquid crystal display, it is displaying by reflecting the incident light from the outside by the reflector.
[0005] Without being influenced so much by the surrounding luminosity, in order to display here using a back light as mentioned above in the case of a penetrated type liquid crystal display, although it has the advantage that the display which is bright and has high contrast can be performed, since a back light consumes 50% or more of the total power consumption of a liquid crystal display, it also usually has the problem that power consumption will become large.
[0006] Moreover, in the case of the reflected type liquid crystal display, although it has the advantage that power consumption can be made very small in order not to use a back light as mentioned above, it also has the problem that the luminosity and contrast of a display by a surrounding operating environment or surrounding service conditions, such as a luminosity, will be influenced.
[0007] Thus, in the reflected type liquid crystal display, when operating environments, such as a surrounding luminosity, especially outdoor daylight were dark, it had the fault that visibility fell extremely, and also in the one transparency type liquid crystal display, with this, when outdoor daylight was very bright conversely, it had the problem that the visibility under fine weather etc. will fall.
[0008] As a means for solving such a trouble, the liquid crystal display having the function of both a reflected type and a penetrated type is proposed by Japanese Patent Application No. No. 201176 [nine to] etc. The liquid crystal display proposed by this patent application By making the reflective display which reflects outdoor daylight in one display pixel, and the transparency display which penetrates the light from a back light, when the circumference is pitch-black As a penetrated type liquid crystal display which displays using the light which penetrates the transparency display from a back light, when outdoor daylight is dark As a two-ways type liquid crystal display which displays using both the light which penetrates the transparency display from a back light, and the light reflected by the reflective display formed with the comparatively high film of the rate of a light reflex Furthermore, when outdoor daylight is bright, it is the transparency reflective two-ways type liquid crystal display of the composition that it can use as a reflected type liquid crystal display which displays using the light reflected by the reflective display formed with the comparatively high film of the rate of a light reflex.
[0009] The liquid crystal display of such composition is not concerned with the luminosity of outdoor daylight, but enable offer of a liquid crystal display in which visibility was always excellent, and as the production method currently

enforced For example, after forming the transparent electrode for bus wiring, TFT, and transparency displays etc. on a substrate, Form the layer insulation film which becomes these upper parts from a photopolymer etc., and it removes completely by exposing and developing the photopolymer in the contact section and a transparency display. Two or more concavo-convex patterns are formed by heat-treating, after minding a shading means by which the circular shading field was arranged and exposing and developing a photopolymer so that the reflection property optimal about the portion which serves as a reflective display on a photopolymer simultaneously may be obtained for example. And the method of forming the reflector for reflective displays which consists of a metal thin film in accordance with the configuration of the concavo-convex section on this concavo-convex pattern is used.

[0010] Moreover, generating of the duplex projection under the influence of the glass thickness which poses a problem by forming a reflecting plate in the outside (a liquid crystal layer being an opposite side) of a substrate is solved by forming a reflecting plate in the interior of a substrate, and carrying out to a pixel electrode and the structure as which it serves, i.e., a reflector.

[0011]

[Problem(s) to be Solved by the Invention] Although offer of a liquid crystal display in which the liquid crystal display of such composition was not concerned with the luminosity of outdoor daylight, but visibility was always excellent is enabled In order to realize bright high color display of color purity with both a penetrated type and a reflected type In order to obtain the display grace which needed to be made to increase the luminous intensity scattered about in the direction perpendicular to the display screen to the incident light from all angles, and was stabilized as a liquid crystal display, suppose that it is always fixed in each display, without changing a reflection property and a transparency property.

[0012] For that purpose, it is required to produce the transparent electrode which has the reflector and the optimal transparency property of having the optimal reflection property. While forming the reflector which formed the irregularity controlled since it had the optimal reflection property in the front face of the substrate which consists of glass etc., and formed on it the thin film which consists of a metal membrane etc. The element about the patterning precision in a membrane formation process, a FOTORISO process, an etching process, etc. is controlled severely, and it needed to be made for the effective screen product of a reflector and a transparent electrode to become always fixed when producing a reflector and a transparent electrode.

[0013] this invention is made in view of such a conventional trouble, and the place made into the purpose is by seting always constant the effective screen product of the transparent electrode in the pixel portion of a transparency reflective two-ways type liquid crystal display, and a reflector to offer transparency reflective two-ways [which can obtain the always stabilized display grace] type a liquid crystal display and its manufacture method.

[0014]

[Means for Solving the Problem] In order to attain the purpose mentioned above, the liquid crystal display of this invention On the substrate of the one side of the substrates of the couple which counters mutually and is arranged on both sides of a liquid crystal layer In the liquid crystal display with which it comes to form the pixel electrode which constitutes the reflective display which reflects outdoor daylight, and the transparency display which penetrates the light from the source of a back light in 1 pixel While the reflective display and transparency display which constitute the aforementioned pixel electrode are constituted by the electrode material, respectively Through a layer insulation film, these electrode materials superimpose a part or all, and it comes to constitute them. on the aforementioned layer insulation film While the level difference ramp which has inclination is formed in the border area of the aforementioned reflective display and a transparency display, it is characterized by being constituted so that the edge of the electrode material which constitutes the aforementioned reflective display may be located on the level difference ramp of the aforementioned layer insulation film.

[0015] In order to attain the purpose mentioned above, moreover, the manufacture method of the liquid crystal display of this invention On the substrate of the one side of the substrates of the couple which counters mutually and is arranged on both sides of a liquid crystal layer In the manufacture method of a liquid crystal display of coming to form the pixel electrode which constitutes the reflective display which reflects outdoor daylight, and the transparency display which penetrates the light from the source of a back light in 1 pixel the above -- with the process which carries out patterning of the transparent-electrode material, and forms it on the substrate of one side including the field which constitutes a transparency display even if few the above -- with the process which carries out patterning of the layer insulation film, and forms it on the aforementioned transparent electrode including the field which constitutes a reflective display even if few While containing the process which carries out patterning of the reflector material to the field which constitutes the reflective display on the aforementioned layer insulation film, and forms it in it and forming in the border area of the reflective display of the aforementioned layer insulation film, and a transparency display the level difference ramp which has inclination The edge of the reflector material which constitutes the aforementioned

reflective display is characterized by carrying out patterning so that it may be located on the level difference ramp formed in the aforementioned layer insulation film.
[0016] Hereafter, an operation of this invention is explained.
[0017] In the border area of a transparency display and a reflective display, in consideration of the alignment gap with a layer insulation film and a reflector, the reflector edge in the border area of a transparency display and a reflective display consists of the liquid crystal display and its manufacture method of this invention so that it may be located in the level difference ramp of the aforementioned layer insulation film so that the electrode material which constitutes a transparency display, and the electrode material which constitutes a reflective display may not contact directly.
[0018] That is, this invention is characterized by the edge of the reflector material 4 which constitutes the aforementioned reflective display C carrying out patterning of the reflector material 4 so that it may be located for example, on the level difference ramp 17 formed in this layer insulation film 3 while the level difference ramp 17 which has inclination is formed in the border area B of the reflective display C of the aforementioned layer insulation film 3, and the transparency display A, as shown in drawing 7 . (In addition, the sign 18 in drawing shows the irregularity formed in the field of the reflective display C on the layer insulation film 3.) The portion which does not contribute to a reflective display substantially at a transparency display (from inclining, it cannot indicate by reflective correctly and cannot indicate by transparency correctly by the voltage drop.) By forming the edge of the reflector material 4 so that it may be located on this level difference ramp 17 since it has become Though area change of the reflector by dispersion in patterning precision occurs If it is within the limits of this level difference ramp 17, it is possible not to affect change of the effective screen product of a reflective display and a transparency display, and to set always constant the effective screen product of the transparent electrode in the pixel portion of a transparency reflective two-ways type liquid crystal display and a reflector.
[0019] If the edge of the reflector material 4 is formed so that it may be located in the reflective display C as this point is shown in drawing 8 , the effective area of the transparency display A changes and it is shown in drawing 9 by dispersion in patterning precision, if the edge of the reflector material 4 is formed so that it may be located in the transparency display A, the effective area of the reflective display C will change with dispersion in patterning precision similarly.
[0020] Thus, according to this invention, it sets to the border area of a transparency display and a reflective display. So that the electrode material which constitutes a transparency display, and the electrode material which constitutes a reflective display may not contact directly While the problem of the melanism by the corrosion by electric corrosion and reduction of an electrode material is solvable by considering as the composition in consideration of the alignment gap with a layer insulation film and reflector material It is possible to realize the transparency reflective two-ways type liquid crystal display permeability and whose reflection factor became possible [always making effective area of the transparency display in a transparency reflective two-ways type liquid crystal display and a reflective display into a fixed size], and were stable.
[0021]
[Embodiments of the Invention] Hereafter, the form of the operation in this invention is explained based on a drawing.
[0022] (Form 1 of operation) Drawing 1 is the plan having shown the composition of the pixel portion of the liquid crystal display in the form 1 of this operation, and drawing 2 is the A-A'line cross section.
[0023] Moreover, drawing 3 (a) - (d) and drawing 4 (e) - (h) is the cross section having shown the process of the transparency display and reflective display in a pixel portion of a liquid crystal display in the form 1 of this operation.
[0024] The transparency display and reflective display which constitute the pixel portion of the liquid crystal display in the form 1 of this operation are explained with reference to drawing 1 -4. first, it is shown in drawing 3 (a) -- as -- the insulating substrate 1 top -- as a base coat film -- Ta2 -- insulator layers, such as O5 and Si02, are formed (not shown), after that, patterning of the metal thin film which becomes the insulating substrate 1 from aluminum, Mo, Ta, etc. is created and carried out by the sputtering method, and the gate electrode 8 is formed
[0025] Next, the gate electrode 8 mentioned above is covered and the laminating of the gate insulator layer 10 is carried out on the insulating substrate 1. With the form 1 of this operation, by P-CVD, 3000A laminating of the SiNx film was carried out, and it considered as the gate insulator layer 10. In addition, in order to raise insulation, the gate electrode 8 is anodized, this oxide film on anode is made into the 1st gate insulator layer 9, the insulator layers 10, such as SiN, are formed by CVD, and it is good also as the 2nd insulator layer 10.
[0026] Next, by CVD, the channel layer 11 (amorphous silicon) and the electrode contact layer 12 (the amorphous silicon or microcrystal (Si) which doped impurities, such as Lynn) are continued on the gate insulator layer 10, 500A laminating is carried out to 1500A, respectively, patterning of both the Si film of the electrode contact layer 12 and the channel layer 11 is carried out by the dry etching method by HCl+SF6 mixed gas etc., and it is formed.
[0027] Then, as shown in drawing 3 (b), 1500A laminating of the transparent electric conduction film (ITO) 13 is

carried out as an electrode material which constitutes a transparency display by the sputtering method, then the laminating of the metal thin films 14 and 15, such as aluminum, Mo, and Ta film, is carried out. And the source electrodes 13 and 14 and the drain electrodes 13 and 15 are formed by carrying out patterning of these.
[0028] Next, as shown in drawing 3 (c), after carrying out 3000A laminating of the insulator layers, such as SiN, in CVD, patterning is carried out and an insulator layer 7 is formed.
[0029] Next, two or more concavo-convex sections 18, the contact section, and a transparency display are formed by heat-treating, after applying the photopolymer 3 used as a layer insulation film on this insulator layer 7 and exposing and developing this photopolymer 3, as shown in drawing 3 (d). In addition, the photopolymer 3 which is this layer insulation film is formed by 30000A thickness, and patterning of the level difference ramp 7 of the portion equivalent to the border area of a reflective display and a transparency display is carried out so that it may become about 45-degree inclination.
[0030] Next, as shown in drawing 4 (e), the reflector which consists of aluminum/Mo films 4 and 5 as an electrode material which constitutes a reflective display on the substrate 1 containing a photopolymer 3 is formed 1000/500A thickness by the sputtering method.
[0031] And as shown in drawing 4 (f), on the electrode material which constitutes a reflective display, a photo lithography process is used and a photoresist 16 is formed at a predetermined configuration. Since Mo5 exists between ITO2 which is the electrode material which constitutes a transparency display, and aluminum4 which is the electrode material which constitutes a reflective display at this time, although an electrolytic solution sinks in from the film defective part of aluminum4 at the time of the development of a photoresist 16, since this Mo5 functions as a barrier metal, an electric corrosion reaction does not occur.
[0032] Moreover, in case patterning of the electrode material which constitutes a reflective display from a following process is carried out at this time, it is necessary to make it ITO2 in the border area of a transparency display and a reflective display and aluminum4/Mo5 not contact directly. That is, in consideration of the alignment gap with the layer insulation film 3 and reflectors 4 and 5, as shown also in the cross section of drawing 2 , the edge of the aforementioned photoresist 16 in a border area with a transparency display and a reflective display carries out exposure development so that it may be located in the level difference ramp 7 of the aforementioned layer insulation film 3. Since the level difference ramp 7 of the layer insulation film 3 is a portion which does not participate in a transparency display at a reflective display, either by considering as such arrangement composition, even if it is the case where the patterning precision of a reflector varies somewhat, a reflection factor and permeability are stabilized, the effective screen product of a transparent electrode and a reflector can always be made regularity, and it is possible to realize always stabilized display grace.
[0033] And as shown in drawing 4 (g), the etchant which consists of nitric-acid + acetic-acid + phosphoric-acid + water is used, aluminum4/Mo5 which are the electrode material which constitutes a reflective display are **********ed simultaneously, and a reflector is formed.
[0034] Finally, as shown in drawing 4 (h), the pixel portion of the liquid crystal display in the form 1 of this operation is completed by removing the photoresist 16 formed of photo lithography using the exfoliation equipment of a batch type.
[0035] Here, the ablation equipment of a batch type used in order to remove the photoresist 16 formed of the aforementioned photo lithography is explained using drawing 5 . Drawing 5 (a) - (c) is the schematic diagram having shown the ablation process of the photoresist 16 of the batch type in the gestalt 1 of this operation.
[0036] the substrate 20 which passed through a process which was mentioned above as shown in drawing 5 (a) - (c) -- as an amine -- MEA (monoethanolamine) -- 60wt(s)% -- it soaks in the ablation liquid 21 to contain, and in order to remove the ablation liquid 21 of substrate 20 front face after that, it soaks in water 22 and rinses At this time, in process in which the substrate 20 as shown in drawing 5 (b) is conveyed from an ablation tub to a rinse tank, it is in the state where ablation liquid 21 adhered to substrate 20 front face, and by soaking this substrate 20 in a rinse tank, MEA21 and water 22 are mixed on substrate 20 front face, and alkalinity becomes strong.
[0037] Therefore, in the liquid crystal display of composition like before, since ITO2 which is the electrode material which constitutes a transparency display in the border area of a transparency display and a reflective display, and aluminum4/Mo5 which are the electrode material which constitutes a reflective display adjoin and they are constituted in case a photoresist 16 is removed, electric corrosion will arise.
[0038] However, with the gestalt 1 of this operation, as mentioned above, it sets to the border area of a transparency display and a reflective display. As are shown in the cross section of drawing 2 and not directly contacted in ITO2 which is the electrode material which constitutes a transparency display, and aluminum4/Mo5 which are the electrode material which constitutes a reflective display Since the edge of the aforementioned photoresist 16 in a border area with a transparency display and a reflective display is constituted in consideration of the alignment gap with the layer

insulation film 3 and reflectors 4 and 5 so that it may be located in the level difference ramp 7 of the aforementioned layer insulation film 3 A photoresist 16 can be removed without causing electric corrosion between ITO which is transparent-electrode material, and aluminum which is reflector material.

[0039] An orientation film is applied and calcinated to each of the TFT substrate which has the pixel portion manufactured as mentioned above, and the transparent opposite substrate (not shown) in which the transparent electrode was formed. And rubbing processing is performed to this orientation film, after sprinkling a spacer, liquid crystal is poured in for both these substrates by lamination and the vacuum pouring-in method by the seal resin, and a liquid crystal display element is created. In addition, with the gestalt 1 of this operation, in order to make it operate in the liquid crystal mode of level orientation, it set up so that each direction of rubbing might become parallel, and the dielectric constant anisotropy poured in the positive nematic liquid crystal. Finally, it installs a polarizing plate and one phase contrast board at a time in the both sides of a liquid crystal display element, respectively, a back light is installed in a tooth back, and the transparency reflective two-ways type liquid crystal display in the gestalt 1 of this operation is completed.

[0040] (Gestalt 2 of operation) Although the gestalt 1 of operation mentioned above explained how to remove the photoresist 16 formed of photo lithography using the ablation equipment of a batch type, the gestalt 2 of this operation explains how to remove the photoresist 16 formed of photo lithography using the ablation equipment of single wafer processing.

[0041] Drawing 6 (a) - (d) is the schematic diagram having shown the ablation process of the photoresist 16 in the gestalt 2 of this operation. In addition, the same flow as the gestalt 1 of operation mentioned above will perform the manufacturing process of the liquid crystal display in the gestalt 2 of this operation except the ablation process of a photoresist 16.

[0042] the substrate 20 which passed through the process of drawing 3 in the gestalt 1 of operation, and drawing 4 as shown in drawing 6 (a) - (d) -- as an amine -- MEA (monoethanolamine) -- 60wt(s)% -- it soaks in the ablation liquid 21 to contain, and in order to remove the ablation liquid 21 of substrate 20 front face after that, it soaks in water 22 and rinses At this time, in process in which the substrate 20 as shown in drawing 6 (c) is conveyed from an ablation tub to a rinse tank, it is in the state where ablation liquid 21 adhered to substrate 20 front face, and this substrate 20 is soaked in a rinse tank, and the ** alkalinity with which MEA21 and water 22 are mixed on substrate 20 front face becomes strong by things.

[0043] Therefore, it sets to the liquid crystal display of composition like before. Although electric corrosion will arise since ITO2 which is the electrode material which constitutes a transparency display in the border area of a transparency display and a reflective display, and aluminum4/Mo5 which are the electrode material which constitutes a reflective display adjoin and they are constituted in case a photoresist 16 is removed Also in the form 2 of this operation, as mentioned above, it sets to the border area of a transparency display and a reflective display. As are shown in the cross section of drawing 2 and not directly contacted in ITO2 which is the electrode material which constitutes a transparency display, and aluminum4/Mo5 which are the electrode material which constitutes a reflective display Since the edge of the aforementioned photoresist 16 in a border area with a transparency display and a reflective display is constituted in consideration of the alignment gap with the layer insulation film 3 and reflectors 4 and 5 so that it may be located in the level difference ramp 7 of the aforementioned layer insulation film 3 A photoresist 16 can be removed without causing electric corrosion between ITO which is transparent-electrode material, and aluminum which is reflector material.

[0044]

[Effect of the Invention] According to the liquid crystal display and its manufacture method of this invention, like the above explanation So that the electrode material which constitutes a transparency display, and the electrode material which constitutes a reflective display may not contact directly in the border area of a transparency display and a reflective display While the problem of the melanism by the corrosion by electric corrosion and reduction of an electrode material is solvable by considering as the composition in consideration of the alignment gap with a layer insulation film and reflector material It is possible to realize the transparency reflective two-ways type liquid crystal display permeability and whose reflection factor became possible [always making effective area of the transparency display in a transparency reflective two-ways type liquid crystal display and a reflective display into a fixed size], and were stable.

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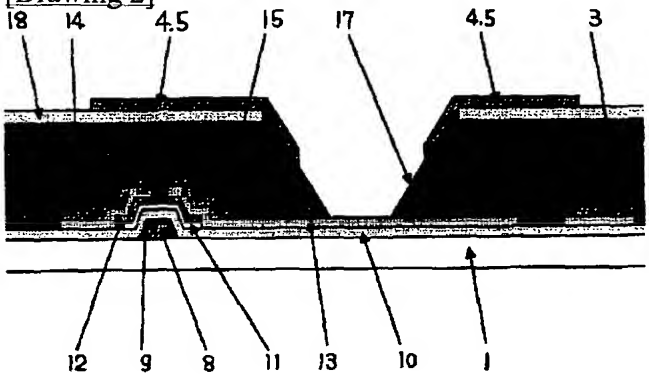
DRAWINGS

[Drawing 2]



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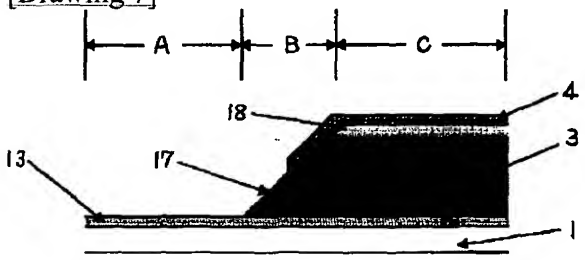
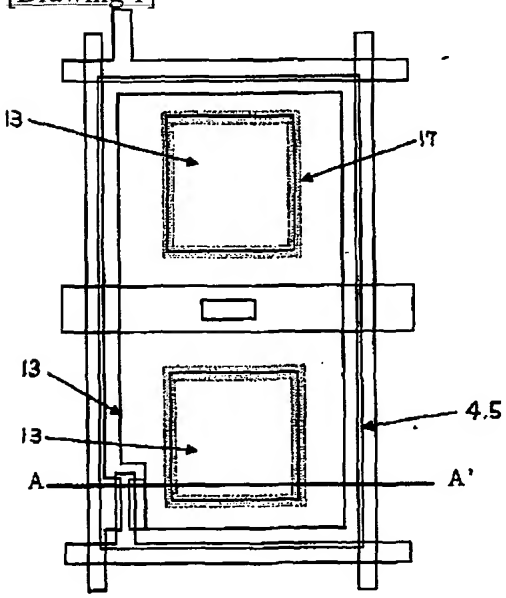


[Drawing 1]



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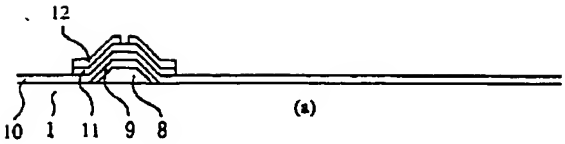

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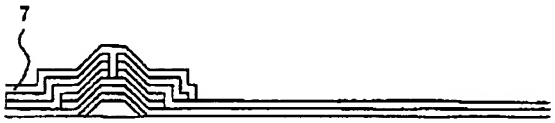

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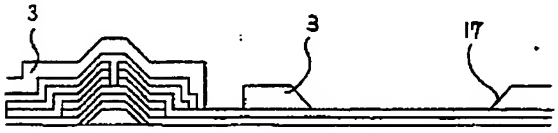
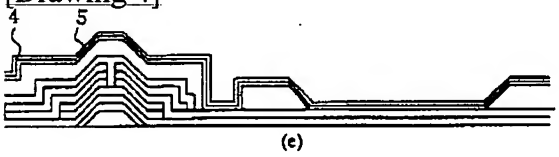


(d)

[Drawing 4]



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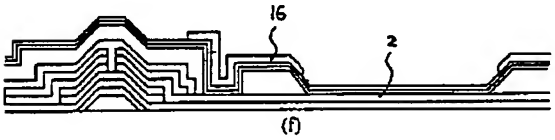

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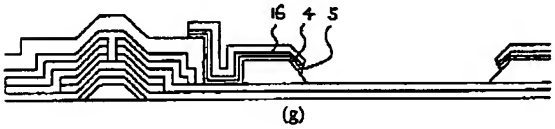

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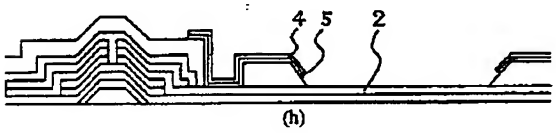
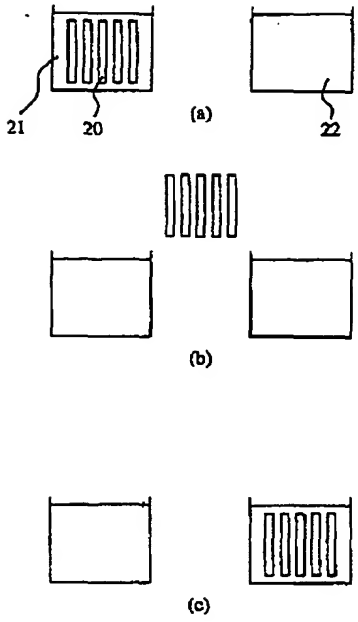
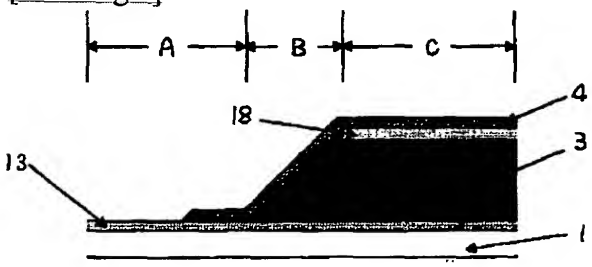


(h)

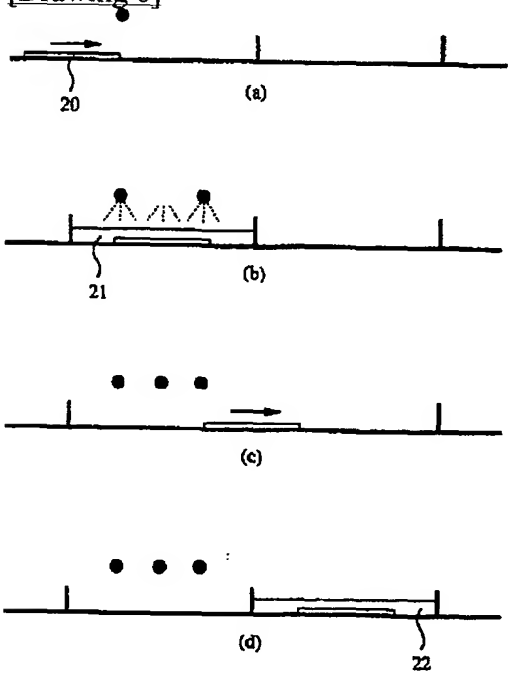
[Drawing 5]



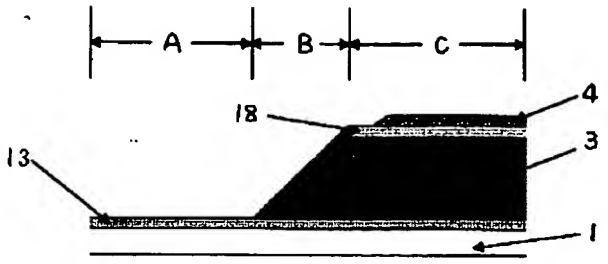
[Drawing 8]



[Drawing 6]



[Drawing 9]



[Translation done.]